REMARKS

Claims 1-2 and 7-15 are pending in this application. Claim 1 is independent. Claim 15 is withdrawn from consideration pursuant to a Restriction Requirement.

The present invention provides a titanium alloy material with improved hydrogen adsorption resistance that can be used without risk of hydrogen embrittlement fracture in environments where hydrogen can be easily absorbed. Specification at title; page 1, lines 5-10; page 4, lines 6-10. The titanium alloy material comprises a Ti-Al alloy, and an oxide film on the Ti-Al alloy. A synergistic effect is obtained between the blocking of hydrogen diffusion by the oxide film and suppression of hydrogen diffusion by the parent alloy so that a highly enhanced hydrogen absorption resistance is obtained. Specification at page 8, lines 13-16. Between the Ti-Al alloy and the oxide film is an Al concentration layer, which has an Al concentration that is 0.3% higher or more than that of the Ti-Al alloy and which provides the titanium alloy material with even better hydrogen absorption resistance properties. Specification at page 5, lines 7-12.

Claims 1-2, 8 and 13-14 are rejected under 35 U.S.C. § 103(a) over EP 1 126 139 A2 ("EP-139") in view of *Corrosion Science* 1999, 2031-2051 ("Yen") and further in view of JP 61276996A ("JP-996").

Claim 2 is rejected under 35 U.S.C. § 103(a) over EP-139 in view of Yen and further in view of JP-996 and JP 04143235A ("JP-235").

Claims 5, 7 and 11 are rejected under 35 U.S.C. § 103(a) over EP-139 in view of Yen and further in view of JP-996 and U.S. Patent No. 4,465,524 ("Dearnaley").

Claim 9 is rejected under 35 U.S.C. § 103(a) over EP-139 in view of Yen and further in view of JP-996 and U.S. Patent No. 6,066,359 ("Yao").

Claims 10 and 12 are rejected under 35 U.S.C. § 103(a) over EP-139 in view of Yen and further in view of JP-996 , Dearnaley and Yao.

> As reiterated by the Supreme Court in *KSR*, the framework for the objective analysis for determining obviousness under 35 U.S.C. 103 is stated in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966). Obviousness is a question of law based on underlying factual inquiries. The factual inquiries enunciated by the Court are as follows:
>
> (A) Ascertaining the differences between the claimed invention and the prior art; and
>
> (B) Ascertaining the differences between the claimed invention and the prior art; and
>
> (C) Resolving the level of ordinary skill in the pertinent art.
>
> **Objective evidence** relevant to the issue of obviousness ***must be evaluated*** by Office personnel. *Id.* at 17-18, 148 USPQ at 467. Such evidence, sometimes referred to as "secondary considerations," may include evidence of commercial success, long-felt but unsolved needs, failure of others, and unexpected results. The evidence may be included in the specification as filed, accompany the application on filing, or be provided in a timely manner at some other point during the prosecution. MPEP 2141.II (emphasis added).
>
> Applicants can rebut a *prima facie* case of obviousness based on overlapping ranges by showing the criticality of the claimed range. "The law is replete with cases in which the difference between the claimed invention and the prior art is some range or other variable within the claims. . . . In such a situation, the applicant must show that the particular range is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art range." MPEP 2144.05.III.

Any *prima facie* case of obviousness based on the cited prior art is rebutted by the significant improvement in hydrogen absorption resistance that is achieved in accordance with independent Claim 1 with a "titanium alloy material comprising a Ti-Al alloy comprising 0.50 - 3.0 mass% of Al, and a balance of Ti and unavoidable impurities; an oxide film on the Ti-Al alloy; and an Al concentration layer between the Ti-Al alloy and the oxide layer, wherein the oxide film has a thickness of 1.0 - 100 nm; the oxide film comprises Al and 50 mass% or more of a crystalline oxide; the Al concentration layer has an Al concentration in a range of from 0.8-25 mass%; and **the Al concentration of the Al concentration layer is 0.3 mass% or more higher than an Al concentration of the Ti-Al alloy**". This is demonstrated by the data in the attached Declaration Under 37 CFR 1.132 and in the specification at Table 3, reproduced below.

Table 3

Sample No.	Chemical Composition (mass%)							Surface oxide film			Al concentration layer		Absorbed hydrogen amount *2	Remarks
	Al	Fe	Mo	Ni	Nb	Mn	Ti	Film thickness (nm)	Crystallinity (%)	Structure *1	Al mass%	Thickness (μm)		
41	0.02	0.07	0.02	0.07	0.02	0.01	bal.	5.0	8.3	R	-	-	×	Comparative Example
42	0.50	0.17	0.08	0.08	0.08	0.03	bal.	0.9	10.2	R	(0.50)	-	△	Example
43	2.98	0.08	0.08	0.06	0.08	0.02	bal.	0.8	25.3	B	(0.51)	-	△	Example
44	2.08	0.09	0.08	0.06	0.08	1.01	bal.	1.2	20.5	B	(2.08)	-	○	Example
45	1.50	0.08	0.08	0.07	0.07	0.02	bal.	13	50.2	B	(1.50)	-	○○	Example
46	0.51	0.08	0.08	0.22	0.07	0.02	bal.	5.4	9.8	R	0.82	0.09	○○○	Example
47	0.51	0.07	0.05	0.15	0.06	0.02	bal.	10	30.2	R	0.81	0.08	○○○	Example
48	0.52	0.07	0.11	0.10	0.06	0.01	bal.	1.5	50.1	R	0.82	0.09	○○○	Example
49	2.85	0.08	0.06	0.13	0.06	0.02	bal.	20.3	50.5	B	5.92	0.09	○○○	Example
50	0.51	0.19	0.08	0.06	0.08	0.02	bal.	11	10.7	R	1.31	0.10	○○○○	Example
51	0.52	0.10	0.08	0.15	0.08	0.02	bal.	50.6	10.5	R	1.22	0.11	○○○○	Example
52	1.56	0.11	0.11	0.10	0.06	0.01	bal.	12	9.9	B	2.97	0.10	○○○○	Example
53	2.98	0.08	0.06	0.13	0.06	0.02	bal.	20.3	11.2	B	5.92	0.12	○○○○	Example
54	2.98	0.08	0.06	0.13	0.06	0.02	bal.	10	20.6	B	3.45	29.9	○○○○	Example
55	0.50	0.18	0.08	0.15	0.07	0.02	bal.	95	50.3	R	1.39	0.23	○○○○	Example
56	0.52	0.07	0.08	0.14	0.04	0.01	bal.	30	99.1	R	0.82	1.5	○○○○	Example
57	1.49	0.08	0.09	0.10	0.04	0.01	bal.	1.2	96.5	R	2.33	0.15	○○○○	Example
58	2.81	0.08	0.06	0.13	0.06	0.02	bal.	8.6	75.1	B	4.92	3.3	○○○○	Example
59	2.98	0.08	0.09	0.10	0.04	0.01	bal.	99	95.5	B	3.58	30	○○○○	Example

(NB)
*1 Crystal structure: R: Rutile, A: Anatase, B: Brookite
*2 Hydrogen absorption amount
○○○○: less than 10ppm, ○○○: 10-49pppm, ○○: 50-99ppm,
○: 100-499ppm, △: 500-999ppm, ×: 1000ppm or more

Table 3 shows that in comparative Sample Nos. 42-45, with Al concentration layers where the Al concentration of the Al concentration layer was equal to or less than an Al concentration of the underlying Ti-Al alloy, the absorbed hydrogen amount was "50-99ppm", "100-499ppm" or "500-999ppm".

The attached Declaration Under 37 CFR 1.132 shows that in a comparative sample, with an Al concentration layer where the Al concentration of the Al concentration layer was 0.25 mass% more than the Al concentration of the Ti-Al layer, the absorbed hydrogen amount was "500 to 999 ppm".

In contrast, Table 3 shows that in Sample Nos. 46-59, with Al concentration layers where the Al concentration of the Al concentration layer was 0.3 mass% or more higher than an Al concentration of the underlying Ti-Al alloy, the absorbed hydrogen amount was a significantly reduced "10-49ppm" or "less than 10ppm".

The Final Rejection at page 8, lines 14-16, cited Dearnaley for disclosing a doped aluminum layer.

Dearnaley discloses that bodies made of titanium alloy, having surfaces liable to wear, can have their wear resistance improved by coating such surfaces with a layer of aluminum which has been bombarded with ions so as to cause the aluminum to migrate into the titanium alloy. Dearnaley at abstract.

Thus, Dearnaley discloses that implanting titanium with Al improves wear resistance.

However, the cited prior art fails to suggest the significant improvement in hydrogen absorption resistance that is achieved in accordance with independent Claim 1 when, in a titanium alloy material comprising an Al concentration layer between a Ti-Al alloy and an oxide layer, "the Al concentration of the Al concentration layer is 0.3 mass% or more higher than an Al concentration of the Ti-Al alloy".

Thus, any *prima facie* case of obviousness based on the cited prior art is rebutted. As a result, the rejections under 35 U.S.C. § 103(a) should be withdrawn.

Pursuant to MPEP § 821.04, after independent product Claim 1 is allowed, Applicants respectfully request examination and allowance of method Claim 15, which includes all of the limitations of product Claim 1.

In view of the foregoing amendments and remarks, Applicants respectfully submit that the application is in condition for allowance. Applicants respectfully request favorable consideration and prompt allowance of the application.

Should the Examiner believe that anything further is necessary in order to place the application in even better condition for allowance, the Examiner is invited to contact Applicants' undersigned attorney at the telephone number listed below.

Respectfully submitted,

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Attached: Declaration Under 37 CFR 1.132